1-1-2014

Evidence-based recommendations for building better bras for women treated for breast cancer

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Abstract

Participating in exercise is beneficial for women who have been treated for breast cancer. However, not being able to find a comfortable exercise bra can be a barrier to exercise participation. This study aimed to systematically investigate what breast support women treated for breast cancer want when they exercise in order to provide evidence-based recommendations to improve exercise bra designs for these women. Based on 432 responses from a national online survey, frequency and relationship data were analysed (binary logistic regression) to understand exercise bra issues pertinent to this population. These issues included being able to control for asymmetrical cup sizes, managing heightened skin sensitivity, managing fluid (size) fluctuations, managing a prosthesis and restoring body image by restoring shape. This study provides evidence-based recommendations to inform an exercise bra design that will meet the unique needs of women treated for breast cancer. Rigorous, evidence-based evaluations of exercise bras for women treated for breast cancer may contribute to their well-being and quality of life through enhanced designs. Practitioner Summary: Exercise bras worn by women treated for breast cancer were investigated with the aim of improving exercise bra designs, which may ultimately contribute to the well-being and quality of life of these women. Evidence-based recommendations to inform an exercise bra design for women treated for breast cancer are provided.

Keywords

Breast cancer, bra design, bra discomfort, women's health, exercise

Disciplines

Medicine and Health Sciences | Social and Behavioral Sciences

Publication Details

Gho, S. A., Munro, B. J., Jones, S. C. & Steele, J. R. (2014). Evidence-based recommendations for building better bras for women treated for breast cancer. Ergonomics: an international journal of research and practice in human factors and ergonomics, 57 (5), 774-786.

Evidence based recommendations for building better bras for women treated for breast cancer

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Participating in exercise is beneficial for women who have been treated for breast cancer. However, not being able to find a comfortable exercise bra can be a barrier to exercise participation. This study aimed to systematically investigate what breast support women treated for breast cancer want when they exercise in order to provide evidence-based recommendations to improve exercise bra designs for these women. Based on 432 responses from a national online survey, frequency and relationship data were analysed (binary logistic regression) to understand exercise bra issues pertinent to this population. These issues included being able to control for asymmetrical cup sizes, managing heightened skin sensitivity, managing fluid (size) fluctuations, managing a prosthesis and restoring body image by restoring shape. This study provides evidence-based recommendations to inform an exercise bra design that will meet the unique needs of women treated for breast cancer. Rigorous, evidence-based evaluations of exercise bras for women treated for breast cancer may contribute to their well-being and quality of life through enhanced designs.

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1. Introduction

Exercise is consistently regarded as being highly beneficial for women treated for breast cancer (McNeely et al. 2006, Schmitz et al. 2005, Markes, Brockow, and Resch 2006, Speck et al. 2010). In particular, exercise has the potential to improve strength and cardiovascular fitness (McNeely et al. 2010, Schmitz et al. 2009, Markes, Brockow, and Resch 2006), reduce fatigue (Mock et al. 2001, Schwartz et al. 2001), decrease levels of anxiety (Galantino 2003, Speck et al. 2010), improve quality of life (Milne et al. 2008, Kendall et al. 2005), and improve survival through a decreased risk of reoccurrence (Barbaric et al. 2010, Friedenreich et al. 2009). Research suggests, however, that barriers to exercise play a significant role in limiting healthy exercise behaviours among these women (Rogers et al. 2011). In fact, emerging research indicates that for breast cancer survivors, the highest ranked barrier to exercise that can be externally modified is exercise bra discomfort (Gho, Steele, and Munro 2010). Furthermore, women who report exercise bra discomfort are less likely to achieve a minimal recommended level of exercise, even when controlling for age, current breast cancer therapies and surgery type (Gho, Munro, et al. 2013). It has been suggested that side effects of breast cancer treatment such as scarring, lymphoedema and reduced functional ability of the arms contribute to the disproportionate breast discomfort experienced by breast cancer survivors as they attempt to exercise (Gho, Munro, et al. 2013). Although this previous research has established that exercise bra discomfort is a leading barrier to exercise participation, no evidence-based literature is currently available to provide recommendations pertaining to what women treated for breast cancer require in an exercise bra.

Supported only by the skin and thin fibrous bands called Cooper's ligaments, the female breast is relatively free to move over the chest wall (Bowles, Steele, and Munro 2008). Given that excessive breast motion has been linked to the reporting of breast

discomfort and pain (Lorenzten and Lawson 1987, Gehlsen and Albohm 1980, Mason, Page, and Fallon 1999, Starr et al. 2005), this lack of anatomical support within the breast results in women requiring external support in the form of a bra in order to reduce breast discomfort during exercise (Bowles, Steele, and Munro 2008). However, subjective judgements of how comfortable a bra feels to the wearer, or how good a bra looks on the wearer, is as important as limiting breast motion when considering ideal exercise bra design. In one study, McGhee and Steele (2010a) found that, although three high support bras displayed no significant difference in vertical breast displacement, the study participants reported a clear favourite bra, and even perceived their favourite bra to elicit less breast movement than the other bra conditions. Given overall comfort is a key factor in encouraging women to wear supportive bras during exercise, the subjective measures of the look and feel of an exercise bra must be accounted for when developing exercise bra designs for any cohort of women (McGhee and Steele 2010a).

How a woman considers the look and feel of her breasts following breast cancer treatment, particularly surgical removal of a breast or breast tissue, is complex. For some women, the loss of a breast can negatively influence perceptions of their self-image, self-identity and sexuality (Crompvoets 2006). For other women, it is a small price to pay for survival and the ongoing enjoyment of life (Gallagher et al. 2010). Regardless of outlook, every survivor will experience a new normal whereby, following diagnosis, treatment and post treatment periods, the survivor attempts to adjust to the substantial changes their physical, emotional, psychosocial and existential self has undergone as a result of their breast cancer (Gao and Dizon 2013). During this period, the restoration of body image through a well-fitted external breast prosthesis or reconstruction, and an appropriate bra, is vital for women negotiating breast cancer survivorship (Mahon and Casey 2003).

There are currently no guidelines or standards that a bra must meet to be classified as an exercise bra (Bowles, Steele, and Munro 2008). Historically, exercise bras that encapsulate the breasts individually in separate cups (encapsulation bras) have been shown to be more effective in limiting breast motion and related breast pain than bras that compress the breasts as a single unit against the chest wall (compression bras) (Mason, Page, and Fallon 1999, Lorenzten and Lawson 1987). Recent studies indicate, however, that for women with smaller breasts, compression bras appear the most effective in limiting breast motion and related breast pain (Zhou, Yu, and Ng 2013), whereas women with larger breasts find bras that incorporate a combination of encapsulation, elevation and compression most effective (McGhee and Steele 2010a). Regardless of style, a good sports bra must be comfortable to wear, limit breast motion, and be constructed from materials which are primarily non-elastic, non-abrasive and have good moisture management properties (Krenzer, Starr, and Branson 2005). However, even the best designed bra are ineffective if they do not fit properly (Page and Steele 1999, McGhee and Steele 2010b). Therefore, designing an exercise bra that accounts for changes as a result of breast cancer treatment is imperative for the look, feel, fit and function of the exercise bra.

Despite a growing evidence base on the importance of bras to exercise participation, there is currently no scientific evidence focused on exercise bra design for women following their treatment for breast cancer. This is a pertinent issue as bra discomfort is associated with lower levels of exercise, which is linked to poorer health outcomes among this cohort. Furthermore, a rigorous, evidence-based evaluation of exercise bras with an aim to improve exercise bra design, may ultimately contribute to the well-being and quality of life of breast cancer survivors. Therefore, the purpose of this study was to systematically investigate what breast support women treated for breast cancer want when they exercise in order to provide

recommendations for improving exercise bra designs for these women. These evidence-based recommendations will inform exercise bra designs that will ultimately meet the unique needs of women treated for breast cancer when they attempt to exercise.

2. Methods

2.1 Participants and survey implementation

Breast cancer patients who had a registered email address with the Breast Cancer Network Australia (BCNA) Review and Survey group or the Cancer Councils of Victoria or Western Australia were invited by email to complete an online survey. Inclusion criteria were any women over 18 years of age, with a breast cancer diagnosis prior to the survey distribution date. The survey invitation contained a brief introduction to the investigators and the study, as well as a direct link to the uniform resource location (URL), which contained the internet-based survey. The URL was open to responses for four months, and closed when continued promotion of the survey did not elicit any further responses. Due to the anonymity of the data collection procedures, and the 'sharing' nature of the internet, the survey's response rate could not be tracked. However, of the 482 women who visited the initial URL, 432 completed the survey (89.6% completion rate). Participants' informed consent was obtained via a participant information sheet on the first page of the survey to which participants clicked "I agree" in order to progress with the online survey. The University Human Research Ethics Committee approved all data collection procedures (HREC08/326).

2.2 Online survey instrument

The online survey instrument was based on a previously validated paper-based questionnaire (Gho, Steele, and Munro 2010). To validate the online version, seven focus groups with breast cancer patients were conducted (total participants = 20) at community centres around

the greater Sydney area. During these groups, the think-aloud technique was employed (Whitney and Budd 1996) and participants were queried about their understanding, and about the relevance and sensitivity of each question, which lead to changes to facilitate the participants' understanding and ease in navigating the electronic version. Test-retest reliability over seven days was confirmed through administering the scale to 12 breast cancer survivors (twice, seven days apart), and the scale was deemed reliable with an intraclass correlation coefficient of 0.82 (0.78 - 0.85, 95% CI).

The final survey instrument included 68 closed-ended and 11 open-ended items and formed part of a larger body of work with regards to survivorship issues after a breast cancer diagnosis (Gho, et al. 2013). The areas of relevance to the outcomes of the present study were bra cup sizes, types of bras worn during exercise, parts of the exercise bra causing discomfort, important factors when purchasing a bra, and an open-ended query on recommendations for bra designs. Independent participant variables used to analyse these outcomes included age, type of surgery undergone, current treatment, and current levels of exercise. The differentiation of these independent participant variables have been described in depth elsewhere (Gho, et al. 2013). Briefly, the women were divided into groups of being "under 50 years old", or "50 years and over" (Age); having undergone a "lumpectomy" or a "mastectomy" (Surgery); whether they were in "current treatment" or "finished treatment" (Current treatment); and whether they were "sufficiently active" or "insufficiently active" (Exercise) (World Health Organisation) based on their responses.

2.3 Statistical analysis

2.3.1 Descriptive analysis

Answers to the closed-ended items were counted to determine the frequency response for each item. The number of responses to different questions may vary as respondents were given the option to skip questions to minimise participant burden. Study population proportions were therefore calculated as a percentage of the number of women who answered that question.

2.3.2 Relationship analysis (binary logistic regression model)

The parts of a bra causing discomfort were considered in a binary logistic regression to ascertain any associated variables and significant relationships. Whether respondents reported the band, straps, cups or underwire of a bra as causing discomfort was inserted as a dependent variable against the independent variables of age, type of surgery, currently undergoing treatment, and exercise levels. This method of analysis has been successfully used in previous cross-sectional survey data with a breast cancer population (Gho, et al. 2014), and ensures that each independent variable is analysed while controlling for the other independent variables. All statistical analyses were completed using SPSS for Windows software (Version 17.0, SPSS Inc, Chicago, IL, USA).

2.3.3 Open-ended recommendations

Open-ended responses were coded into key reoccurring themes, which were then recoded into higher order themes based on specific parts of the bra, and eventually formed into recommendations for exercise bra design. All open-ended responses were analysed using NVivo 8 for Windows software (QRS International, Melbourne, Australia).

3. Results

3.1 Participant characteristics

Participant characteristics of age, surgery undergone, current treatment, exercise levels, and exercise bra discomfort are provided in Table 1. Only 158 women (36.5%) were considered sufficiently active, which closely matches the percentage of sufficiently active women in an age-matched general Australian female population (37.6%) (Austalian Bureau of Statistics 2011). A total of 184 women reported the bra they currently exercised in was uncomfortable, compared to 230 women who reported no discomfort and 18 who did not respond to this question (42.6%, 53.2% and 4.2%, respectively).

<Insert Table 1 about here>

3.2 Bra size

Table 2 provides a summary of the left and right bra cup sizes of the sample. The C-cup bra size was the most common, with most respondents (n = 83; 20.0%) having both left and right C-cup size breasts. Over half of the respondents (n = 274; 63.4%) had bra cup sizes of C-cup or smaller, although whether this was a natural cup size or due to surgery is unknown, with 157 women (36.3%) reporting asymmetrical cup sizes.

<Insert Table 2 about here>

3.3 Types of exercise bras worn

Mastectomy bras were the most commonly worn exercise bras, with 100 respondents (24.5%) reporting wearing these during exercise (see Figure 1). A standard everyday bra with underwire was the next most commonly worn exercise bra (n = 91; 22.2%). Only one fifth (n = 80; 19.5%) of respondents wore a sports bra (with or without an underwire) as their exercise bra.

<Insert Figure 1 about here>

3.4 Most uncomfortable parts of an exercise bra

Respondents who reported exercise bra discomfort (n = 184) were asked to indicate which parts of their exercise bra caused this discomfort (total responses = 466). Figure 2 indicates that 64.7% of these respondents found the band to be the most uncomfortable part of the bra (n = 119), followed by the straps (n = 83; 45.1%), cups (n = 70; 38.0%) and underwire shape (n = 49; 26.6%). When these four main uncomfortable bra parts were considered in a binary logistic regression model against age, surgery, current treatment, and exercise levels, only the cups and underwire shape showed significant associations (Table 3). Specifically, women who reported the cups of a bra as uncomfortable were more likely to have undergone a lumpectomy (OR = 2.78; 1.28 - 6.03, 95% CI); and women who reported the underwire shape as uncomfortable were more likely to have finished active treatment, or finished taking medication for their breast cancer (OR = 0.44; 0.20 - 0.93, 95% CI).

<Insert Figure 2 and Table 3 about here>

3.5 Causes of exercise bra discomfort

Respondents who reported exercise bra discomfort (n = 184) were also asked to indicate what caused this discomfort (total responses = 425; Table 4). The top 10 causes of bra discomfort during exercise were band being too tight, straps slipping off, band riding up, straps too tight, mismatched cup sizes, band hurts or irritates breast scar, underwire shape hurts or irritates breast scar, cups do not support unaffected breast, cups do not support affected breast, and stitching hurts or irritates breast scar.

<Insert Table 4 about here>

3.6 Important factors when purchasing an exercise bra

Most respondents (52.0%) ranked bra comfort as the most important factor when purchasing an exercise bra (total responses = 383; Figure 3). Secondary to this was whether the bra fitted (22.7% of respondents) and the amount of support it provided (13.0% of respondents).

<Insert Figure 3 about here>

3.7 Open-ended recommendations

A total of 551 references from 306 open-ended responses were coded into key themes and categorised under the main parts of the bra causing discomfort. The four main parts of the bra identified were: (1) the band, with underarm, fabric and sizing recommendations; (2) the cups with seam-free, underwire free, and padding recommendations; (3) the bra straps with fit and orientation recommendations; and (4) fastener recommendations – particularly around ease of removal. Other themes relative to overall comfort, fit, price, and availability were also identified. Open-ended responses supported many of the themes that emerged through the closed-ended data, and quotes to show this are provided throughout the discussion. The need for a bra to look attractive was a key theme identified in the open-ended responses that was not apparent from the closed-ended data.

4. Discussion

The purpose of this study was to systematically investigate what breast support women treated for breast cancer want when they exercise, and to provide evidence-based recommendations for improving exercise bra designs for these women. The study gathered information about current exercise bra use of women treated for breast cancer and the main causes of discomfort these women experienced with their exercise bra. The study also gathered information on what women want in an exercise bra, and their personal recommendations for exercise bra design. This is the first study to examine these outcomes in

the literature to date, and these results will provide evidence to inform exercise bra designs for women treated for breast cancer.

4.1 Bra size

The marked asymmetrical bra cup sizes reported in this cohort is a factor not usually accounted for in exercise bra design. In fact, the proportion (36.3%) of respondents reporting breast asymmetry is significantly larger than the natural breast asymmetry seen among women without a history of breast cancer treatment (approximately 10% deemed clinically significant) (Losken et al. 2005). Historically, exercise bras have not needed to accommodate for breast asymmetry, as studies of a general female population have found no significant difference in the vertical breast displacement between a right and left breast (McGhee, Steele, and Power 2007). However, among women treated for breast cancer, it is apparent that to provide optimal breast support during exercise, the exercise bra must control motion of both the affected breast (and prosthesis), and unaffected breast (Gho, Steele, and Munro 2011). To do this, the ability to inter-change cup sizes or adjust each cup size should be considered.

> "*Make allowance for different size breasts. Since radiotherapy my affected breast does not change in size as my weight fluctuates, so I always have one breast a different size to the other which makes fitting very hard - very tight on one side or loose on the other*." [55 years old; undergone a lumpectomy]

4.2 Types of exercise bras worn

Only about one fifth (n = 80; 19.5%) of respondents wore a sports bra (with or without an underwire). This is much lower than the proportion of women in the general population (41%) who report wearing a bra designed specifically for sport while exercising (Bowles, Steele, and Munro 2008). Researchers attribute the low levels of sports bra usage in the

general population to be primarily due to a lack of awareness regarding the importance of good breast support during physical activity (Bowles, Steele, and Munro 2008). Although this is likely to also contribute to the low levels of sports bra usage among women who have been treated for breast cancer, respondents also cited a lack of availability as a reason for not using an exercise specific bra.

> *"I would like a mastectomy bra specifically made for exercise - haven't come across any."* [50 years old; undergone a mastectomy]

4.3 Most uncomfortable parts of an exercise bra

Women who reported the cups of a bra as uncomfortable were more likely to have undergone a lumpectomy and women who reported the underwire as uncomfortable were more likely to have finished active treatment, and finished taking medication for their breast cancer. Lumpectomy patients are less likely to wear a prosthesis, and may experience the effect of breast asymmetry to a larger degree in standard bra cup sizes than mastectomy patients (Gho, Steele, and Munro 2011). This was also expressed in the open-ended responses as women requested a bra with the option to be "padded out" to fit the cup and match the unaffected breast.

> *"To have an exercise bra which is slightly padded to give a fuller/more rounded even shape for women who have had lumpectomies but no reconstruction and whose breasts may now be of different shapes (difference between the left and right breasts)."* [49 years old; undergone a double lumpectomy]

It is also probable that women currently undergoing treatment for breast cancer would wear a soft, post-surgery bra that does not contain underwire. As they move beyond treatment however, finding an attractive, supportive bra without underwire becomes a significant issue.

"After surgery I wore maternity bras because at 18DD it is difficult to get a supportive bra without underwire. The underwire type is still painful after nearly 10 years." [71 years old; undergone a lumpectomy]

4.4 Causes of exercise bra discomfort

Bra band tightness was reported as the top cause of bra discomfort during exercise. Women without a history of breast cancer treatment have also reported feeling their exercise bra band was too tight around the chest (Bowles, Steele, and Munro 2012). To explore this, Bowles et al. (2005) examined the pressures exerted by a sports bra and a fashion bra on the torso of women as they performed sub-maximal and maximal exercise. The authors found that wearing a professionally fitted encapsulating sports bra resulted in no significant difference in comfort when compared to a fashion bra, and resulted in no decrease in exercise performance. This result highlighted the importance of being correctly fitted for an exercise bra. Furthermore, women who have been treated for breast cancer will experience fluctuations in fluid retention in the axillary area, and around the torso, to an extent not experienced by the general female population. Problems associated with fluctuations in fluid retention are underlined by the finding that the top four reasons cited for bra discomfort in this cohort were two extremes of the same functional bra component; namely, a bra band being too tight or too loose (riding up); and the straps of a bra being too tight or slipping off (too loose). This finding indicates women treated for breast cancer may not be adjusting their bras to fit in response to fluctuations in body weight or fluid retention; or their bras do not permit the adjustability this cohort requires.

The other top causes of breast discomfort that were cited imply the need for better bra cup designs to permit better fit, and to provide the support required during exercise, both for the affected and unaffected breasts. Key design features recommended for exercise bras for

the general population include a high front to fully enclose breast tissue and limit anterior-posterior breast motion; a large side depth to ensure side breast tissue is kept fully within the cup; and extendable yet semi-rigid shoulder straps that stay in contact with the body throughout the movement (Zhou, Yu, and Ng 2013). These features are relevant to the breast cancer cohort, but must also be combined with improved adjustability for fit, and an awareness of the aggravation of breast scar tissue by the functional bra components (band, underwire and stitching).

> *"The change in shape, position and consistency of breasts can make it difficult to find a bra which suits both breasts. Also scaring and damaged skin from radiotherapy can be irritated by the shape of cups and underwire."* [51 years old; undergone a mastectomy]

4.5 Important factors when purchasing an exercise bra

"How comfortable the bra is" was the most important factor influencing bra purchasing in this study. Interestingly, in a study of 13 women aged 45-65 years and not affected by breast cancer, a leading theme influencing everyday bra purchasing was the effect that the bra may have on outward aesthetics, and the woman's shape in it (Risius et al. 2012). Although similar themes have been expressed as being important to women treated for breast cancer, aesthetics ranked fifth (2.9%), following comfort, fit, support and cost, in this cohort. As the following quote illustrates, for many women in the study comfort displaces aesthetic appeal.

> *"I now buy my sport (pull over the head) or soft front opening bras (no padding) from the home delivery magazines. Comfort is the most important, I can no longer wear pretty."* [68 years old; undergone a lumpectomy]

Nevertheless, although aesthetics did not rank highly as a bra purchasing factor for women treated for breast cancer, research has identified the important role body image and appearance to self plays in the psychological and emotional well-being of these women (Gallagher et al. 2009). Therefore, exercise bra designs that focus on both functionality and attractiveness, rather than forcing women to choose between comfort and aesthetics, will be more readily accepted by these women, and better contribute to overall quality of life through both exercise benefits, and improved body image.

> *"I would like to be able to wear a bra that has some elegance to it as well as support and comfort. A bra that enables you to look and feel feminine."* [51 years old; undergone a lumpectomy]

4.6 Summary of exercise bra design recommendations

To fulfil the purpose of this study, closed and open-ended responses from an online survey were systematically analysed to provide evidence-based recommendations pertaining to exercise bra designs for women treated for breast cancer. These recommendations have been discussed throughout this paper, and are summarised in Table 5. It is unlikely that any one bra design or style will satisfactorily meet all these recommendations, across a variety of breast shapes and sizes (McGhee et al. 2013). Rather, it is important that bras are designed to fit a range of breast shapes, while maintaining the design features required to effectively limit breast motion, and to accommodate the effects of breast cancer treatment.

<Insert Table 5 about here>

4.7 Strengths and limitations

Although a validated survey instrument was used, this study was limited in the use of self-reported data and by its cross-sectional design. In particular, women have a poor ability to

select correct bra cup sizes, and therefore any self-reported bra size must be interpreted with caution. Furthermore, as this is the first study to investigate the exercise bra design needs of women treated for breast cancer, comparisons to existing literature specific to this field of research could not be made. Despite these limitations, this study provides valuable insight into an otherwise limited research area. The strengths of the study are that the online survey completion rate was very high (89.6%), providing responses from a large sample of Australian women treated for breast cancer. Furthermore, the electronic nature of survey delivery limited the human error potential, which is present during manual paper-survey data transcriptions into electronic statistical packages.

5. Conclusion

Similar to the general female population, women treated for breast cancer require an exercise bra that effectively minimises breast motion during physical activity, fits properly, and is comfortable to wear. However, the findings from this study highlight that women treated for breast cancer also require an exercise bra that can accommodate their asymmetrical breast sizes, heightened skin sensitivity, increased fluid fluctuations and, if relevant, prosthesis movement. To assist in restoring body image, exercise bras for these women also need to provide a flattering profile, be constructed of soft, breathable, natural materials, and provide complete adjustability. The restoration of body image and self-confidence also plays a major role in the unique needs of women treated for breast cancer. To this end, if an exercise bra can be designed to look good, and give the wearer shape and confidence, as well as be a functional garment, women may be more likely to use them. Furthermore, although minimising breast motion, and the associated breast discomfort, is a fundamental purpose of exercise bras, the findings of this study highlight the importance of first meeting the unique fit and comfort needs expressed by women treated for breast cancer. Finally, evidence-based

exercise bras design recommendations for women treated for breast cancer, such as provided by this paper, can enhance the development of better bra designs, and ultimately contribute to the well-being and quality of life of breast cancer survivors.

5.1 Acknowledgements

We acknowledge the support of the National Breast Cancer Foundation, the Breast Cancer Network Australia and Cancer Councils of Victoria and Western Australia throughout the study.

5.2 Funding

This project was funded by the National Breast Cancer Foundation with the support of Cancer Australia.

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Table 1: Participant characteristics

	n	%
Age		
Mean Age	53.3 ± 9.8 years	
< 30 years	2	0.0
30-49 years	142	33.0
50-69 years	271	63.0
≥ 70 years	17	4.0
Missing	0	0.0
Surgery		
Lumpectomy	187	43.3
Mastectomy	242	56.0
Missing	3	0.7
Current treatment		
Still being treated	239	55.3
Finished all treatment	148	34.3
Missing	45	10.4
Exercise Levels		
Insufficiently active	265	61.3
Sufficiently active	158	36.5
Missing	9	2.2
Experience exercise bra discomfort		
Yes	184	42.6
No	230	53.2
Missing	18	4.2

Table 2: Bra cup sizes for the left and right breasts for sample participants (n = 432). The values in the central diagonal line (shaded) indicate the number of respondents with matching cup sizes (n = 275). The values outside the central line indicate the number of women with mismatched cup sizes (n = 157). The "none" value may have indicated no breast (or prosthesis) or a non-response.

	Left										
Right	None	A	B	C	D	DD	E	F	G	Other	Total
None	23		2	18	3	3		1			50
A	5	21	5	1							32
B	11	8	61	11	2					1	94
C	13	2	10	83	6	1	1			2	118
D	8		1	8	48	7				1	73
DD	3			2	4	16	2				27
E	2				2		9			1	14
F								1			1
G	1							1	3		5
Other			2	2	2	1	1			10	18
Total	66	31	81	125	67	28	13	3	3	15	432

Survey Question: "What is your bra cup size?" Right Breast [closed-ended options]; Left Breast [closed-ended options]

Table 3: Binary logistic regression for parts of a bra being reported by the respondents as being uncomfortable.

		BAND (n = 119)			STRAPS (n = 83)			CUPS (n = 70)			UNDERWIRE (n = 49)		
	n	p-value	OR†	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI
Age													
< 50 yr	144	0.55	1.28	0.57-2.88	0.49	0.77	0.37-1.62	0.67	1.18	0.54-2.61	0.08	0.51	0.24-1.09
≥ 50 yr	288												
Missing	0												
Surgery													
Lumpectomy	187	0.26	0.65	0.30-1.39	0.34	1.41	0.69-2.87	*0.01*	*2.78*	*1.28-6.03*	0.11	0.56	0.26-1.16
Mastectomy	242												
Missing	3												
Current treatment													
Still being treated	239	0.97	0.99	0.45-2.16	0.07	1.98	0.95-4.12	0.45	1.36	0.61-3.05	*0.03*	*0.44*	*0.20-0.93*
Finished all treatment	148												
Missing	45												
Exercise Levels													
Insufficiently active	265	0.27	0.60	0.25-1.49	0.90	0.95	0.43-2.12	0.95	0.97	0.41-2.29	0.94	1.03	0.46-2.33
Sufficiently active	158												
Missing	9												

Survey Question: . "Which parts of your bra feel most uncomfortable when you exercise? ..."
† OR = Odds Ratio

Table 4: Parts of, and causes of, discomfort in an exercise bra reported by the respondents.

	Too tight/ cuts in	Sits on my drain site	Rides up	Hurts/ irritates my breast scar	Causes chafing/ rubbing/ rash	Does not support my unaffected breast	Does not support my affected breast	Mismatched cup sizes	Slip off	Too narrow	Too wide	Too hot	Other	Total
Band	35[1]	7	30[3]	17[6]	10	1	4	3	1	2		1	5	116*
Straps	23[4]		4	2	3	2	2	2	33[2]	6	2		4	83*
Cups		1	4	8	3	14[8]	12[9]	20[5]	1		1	2	3	69*
Underwire shape	8	1	5	15[7]	7		1	3	1				2	44*
Material				5	8			2				10		25
Hooks/ Fasteners	3	1	3	1	6		1			2	1		1	19
Strap adjusters	2		1	1	2	3		1	2					12
Stitching		1		11[10]	6								1	19
Other	7		2	2	1			4				1	2	19
Total	78	11	49	62	46	20	20	35	38	10	4	14	18	425*

*Overall totals do not match frequencies in Table 2 and Figure 2, as not all women reported a cause for their bra part discomfort.
[1-10] Top 10 causes of bra discomfort.

Table 5: Summary of bra design recommendations.

The band of an exercise bra should:

- be wide enough to provide an appropriate level of breast support
- be firm, but not too tight, when fitted properly
- not ride up, especially when there is a lack of an infra-mammary fold
- be made of soft, breathable, and natural materials to prevent skin irritation and to dissipate heat
- be adjustable to accommodate for changes in torso circumference due to factors such as fluid retention
- not cut in under the arm
- have minimal seams to limit scar aggravation

The straps of an exercise bra should:

- be wide and padded to distribute loads borne by the straps over a greater area to prevent bra straps digging into the shoulders
- be adjustable to accommodate for changes in breast size
- not slip off shoulders
- ensure any fasteners and buckles are well encased so they do not “dig in”

The cups of an exercise bra should:

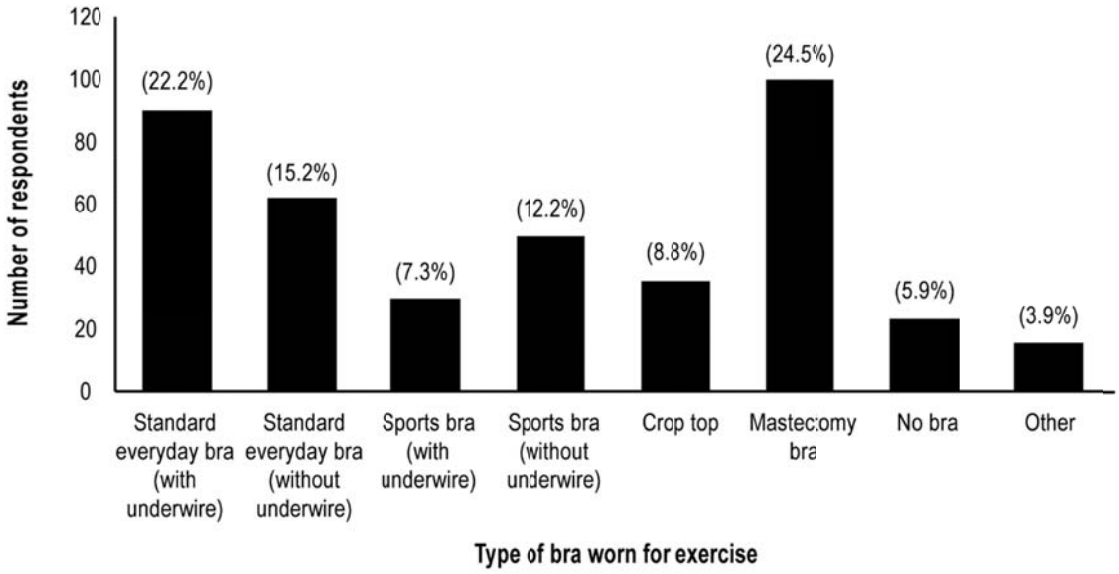
- encase the prosthesis well so it does not fall out
- be padded to hide the nipple (or lack of), and should provide breast shape
- have no stitching or seams that could irritate sensitive breast tissue
- have no underwire that could dig into scar tissue or sensitive breast tissue
- be adaptable to accommodate asymmetrical breast sizes
- be made of soft, breathable, natural materials to prevent skin irritation and to dissipate heat

Other recommendations:

- The bra should look attractive, and provide shape to the wearer to assist in restoring body image and self-confidence
- Bra fit education tools specific to a breast cancer cohort should be developed so that women treated with breast cancer can select a well-fitted bra suited to their exercise needs

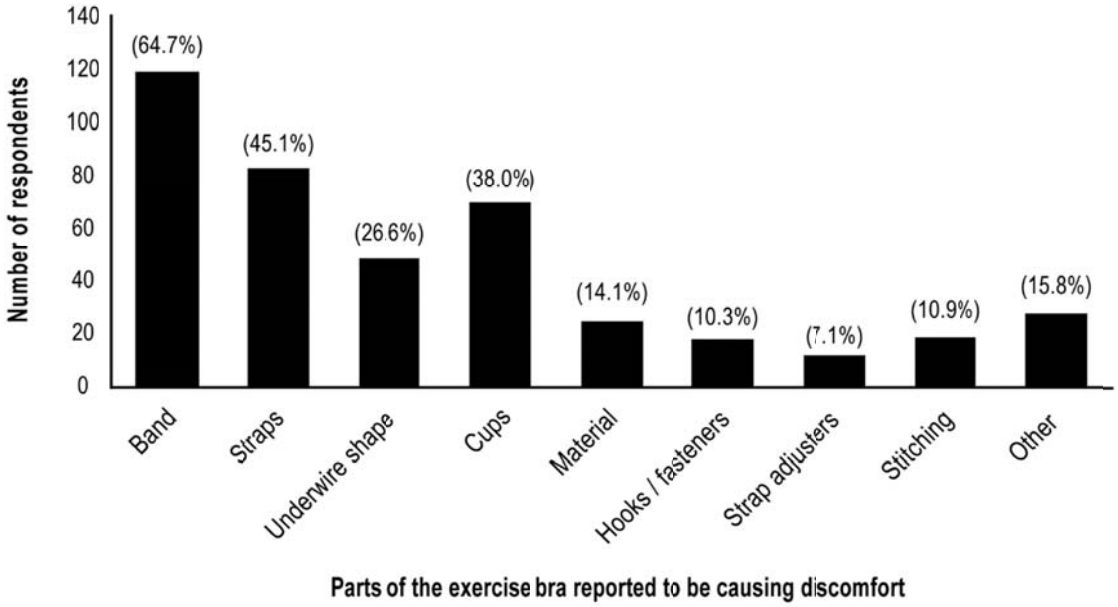
Figures

Figure 1: Types of bras worn by respondents during exercise, by the frequency and proportion of the sample (in parentheses) who reported their exercise bra type (n = 409).



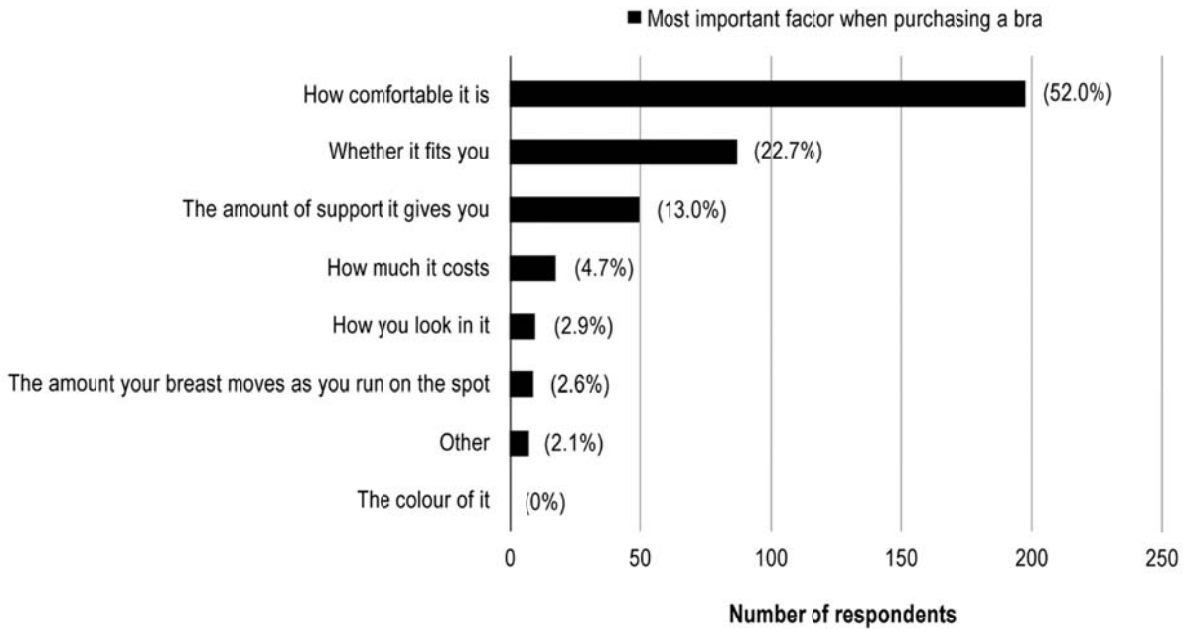
Survey Question: "What type of bra do you CURRENTLY wear when you are exercising?"

Figure 2: Overall parts of the bra causing discomfort during exercise, by the frequency and proportion of the sample (in parentheses) who reported exercise bra discomfort (total responses = 466; total n = 184).



Survey Question: "Which parts of your bra feel most uncomfortable when you exercise? Please select up to 3 parts of the bra which you find most uncomfortable and list them below. Please also specify what bothers you about the parts of the bra you ranked as uncomfortable."

Figure 3: The most important factor when purchasing an exercise bra by the frequency and proportion of the sample (in parentheses) who reported it (item ranked 1 out of possible 7; n = 383).



Survey Question: "Rank the following factors that you think are most important when selecting a new bra to EXERCISE in. For each rank, please select the appropriate factor from the drop-down menus. Rank 1 is the most important and 7 is the least important."